

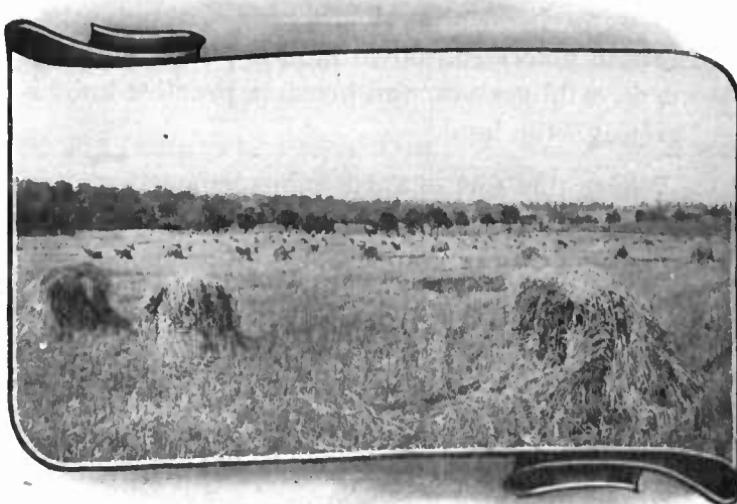
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FARM PRACTICES THAT INCREASE CROP YIELDS IN KENTUCKY AND TENNESSEE

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IN THE LIMESTONE and mountain districts south of the Ohio River there is much land that has been run down by continual cropping without rotation. In some places run-down land is left to grow up in weeds, wild grasses, and brush, a practice known as "resting" the land.

Where this sort of farm management is followed farm manure is largely wasted, little or no attention is paid to green-manure crops or other means of putting humus into the soil, and crop yields are very low. However, progressive farmers throughout the region who have built up run-down lands are now getting heavy yields.

In the following pages are described some of the methods by which these farmers get results by making good use of farm manure and crop refuse, using legumes and grasses in regular rotations, and applying lime and commercial fertilizers.

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CONTENTS.

Page.		Page.	
General description of the region.....	4	Some examples illustrating good farm practice.....	22
Common farm practices.....	7	Practical suggestions on farm practices.....	32
Agencies that have proved successful.....	10		
Rotations	19		

THE EXTENSIVE TERRITORY in the lower Appalachian Mountains and westward, lying east of the Mississippi River and south of the Ohio, generally speaking, forms a distinct agricultural region. Although there are great differences in soils and in climatic conditions, the farm activities and practices of any one section of this region are more or less related to those of any other. Roughly, this area includes the States of Kentucky and Tennessee, the southern part of West Virginia, and the western and more mountainous parts of Virginia and North Carolina. (See fig. 1.)

The more productive lands have been farmed for more than a century, and while in a few localities, where the soil is exceptionally fertile, excellent crops are produced without difficulty, these lands, generally speaking, have been depleted in fertility on account of poor management. Large areas of the hillier lands have been almost wholly abandoned, mainly on account of soil erosion, due principally to bad farm practices.

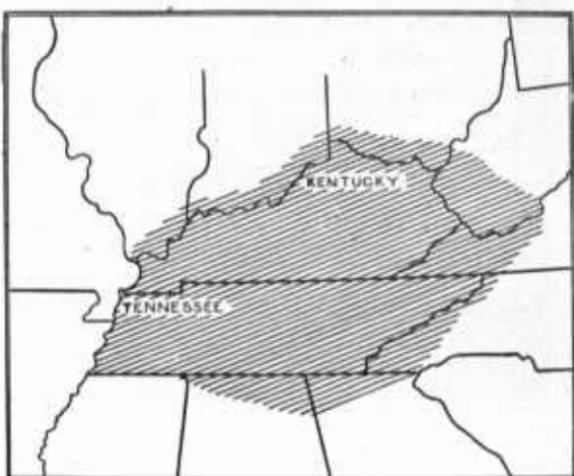


FIG. 1.—Map of area to which this bulletin is applicable.

The most important agricultural problem before most farmers of this region is that of changing from old practices to those new ones which will improve the soil, increase yields, and maintain them.

GENERAL DESCRIPTION OF THE REGION.

Broadly speaking, there are three general classes of agricultural lands in this region: (1) Mountain lands, the soil of which is largely



FIG. 2.—Typical mountain land, showing cultivated areas in the most favorable places. "Coves," which are depressions on the slopes of mountains, are good places for growing corn.

made from the slow decomposition of sandstone and shale; (2) limestone lands, the soil of which is made very largely from the decomposition of limestone; (3) in western Tennessee and extreme western Kentucky silt loam soils, with silty clay subsoils.¹ Besides these there are some alluvial bottom lands along the rivers.

¹ The soils of the third class are derived from material which is supposed to have been deposited by wind and which geologically is known as loess. These wind-blown deposits are thickest near the Mississippi River, thinning out toward the east, with frequent erosional exposures of water-laid sands and sandy clays and gravel. This gives a belt of sandy loam and loam, sometimes gravelly, between the soils derived from the loess and the limestone soils to the east.

The limestone soils are usually heavy clay loams, red to chocolate-brown in color, and are, as a rule, better adapted to agriculture than any of the other soils. Sandstone soils are usually sandy loams of a light yellow color and stony sandy soils, while shale soils, also clay loams, are usually of a light gray color. Soils derived from shale are usually silt loams, with clay subsoils.

Frequently the sandstone and shale areas can be picked out by the denser forest growth which appears in the landscape on the rougher and higher lands, while the limestone areas are usually less rough, average lower in elevation, and are usually occupied by field crops



FIG. 3.—Typical limestone land in western Kentucky and Tennessee. The soil, topography, and market facilities favor the growing of wheat. Dark tobacco is also extensively grown on these lands.

and pastures instead of forest. A detached area of sandstone and shale of considerable extent, covering several counties, extends along the lower course of Green River.

The main limestone areas lie in the bluegrass region of Kentucky, the Nashville Basin, and middle-western Kentucky and Tennessee; also in a belt of valley and ridge land 25 to 50 miles in width between the Blue Ridge Mountain region and the Cumberland Plateau. Bordering these areas, usually at much higher elevations, are the rough mountain lands, formed chiefly of sandstone and shale, with occasionally an outcropping of limestone.

The limestone areas, besides being as a rule better adapted to agriculture than the other areas, on account of topography and soil, have better roads and are more accessible to great market centers by

means of numerous railway lines. Mountain farms, on the other hand, are less accessible to outside markets, have few railways, and the roads are usually bad—during the winter season often being practically impassable. Many of the mountain farms are not accessible even by wagon roads. They can be reached only by winding trails up the sides of mountains and across gaps. Farms such as these have only small areas under cultivation, the aim being to provide sufficient food for a family and the few animals kept, and to avoid a surplus which might be a loss on account of lack of a market. Figure 4 shows a typical farm of this kind. Such farms are frequently seen in traveling through the more inaccessible parts of this region. Some farms,



FIG. 4.—One type of mountain farm home. This house has no windows. The fire-place chimney is built of sticks and mortar.

however, in these less accessible regions have some level land lying along streams and are usually more prosperous. (Fig. 5.)

Notwithstanding these adverse agricultural conditions the mountain districts are, as a rule, as thickly settled as the more favorable limestone areas. Many people, of course, besides being engaged in farming, find work in teaming, cutting timber, sawing lumber, and mining coal. The forests, however, have been largely cut over, and the lumber industry is dying out. The mining of coal in a few places in the southern Appalachians, on the other hand, has developed very rapidly in recent years. This industry doubtless will continue its development and take large numbers of people from the farms.

There are, generally speaking, two kinds of limestone lands; one of these is from older geological formations especially rich in phos-

phorus, one of the essential plant foods. This type is represented in the bluegrass region of Kentucky, the Nashville Basin, and other small areas here and there. The other kind of limestone lands are not as well adapted to bluegrass; they are notably deficient in phosphorus and, strange as it may seem, are greatly improved by liming. This type is chiefly represented in middle-western Kentucky and Tennessee.

Most limestone lands are peculiarly subject to washing, even more so than the steeper mountain lands. If not protected by field crops or meadow or pasture sod, the soil quickly washes away. If the fields are left unprotected, even if for but a year or two, deep gullies

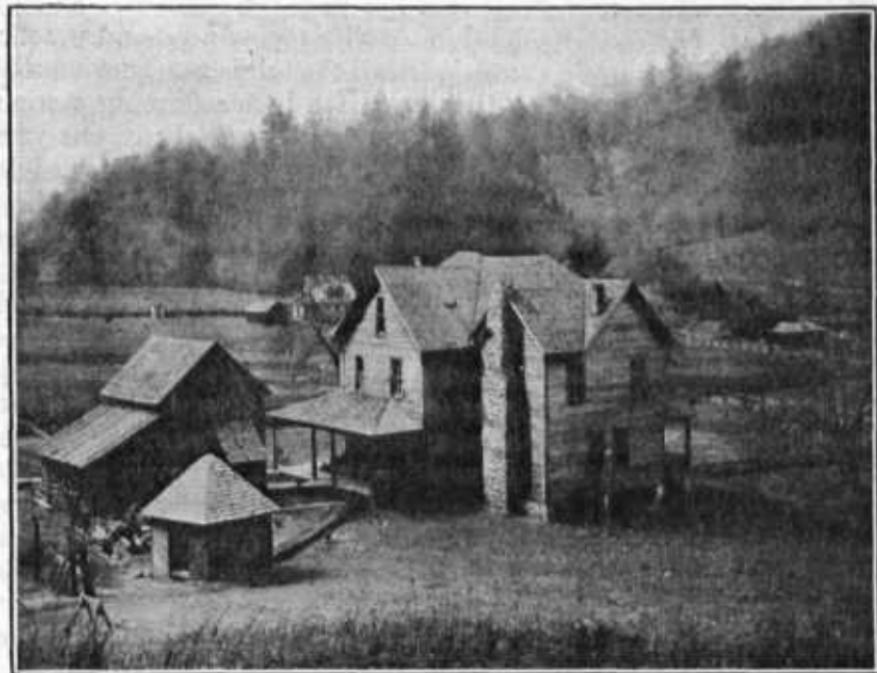


FIG. 5.—Typical farms and farm buildings along the wider river bottom in the mountains. These farms usually consist of part bottom land, and part mountain-side land, the latter used mostly for pasture.

will be formed. Many thousands of acres of these limestone lands, which are somewhat rough in topography, are to-day practically useless as farm lands on account of soil depletion and washing. Before they can be brought into profitable use the gullies will have to be filled up and a cropping system established to bring them back to a good state of fertility.

COMMON FARM PRACTICES.

One outstanding fact regarding this territory is its great diversity of conditions. It is even difficult to find an individual farm on which the soil conditions are the same all over the place. On one

part of a field the soil may be shallow, while in another part it is deep; a patch here and there may be stony, while another part has bad drainage. It is difficult to find farms on which the land is all generally level or all slightly rolling. On many mountain farms even the climatic conditions are different on one part of the farm from those on another, owing to elevation and slope.

These facts have made it difficult for farmers to establish systematic crop rotations such as are commonly found in places where conditions are about the same on all parts of the farm. The farmers in the more favored agricultural areas usually aim at some kind of a crop rotation, but the practice of growing the same crop on a piece of land several years in succession has been too common. In fact, on the rough and steep mountain farms it is quite a general practice to grow the same crop in succession until the soil is nearly exhausted.

The rotation most of the farmers in the better farming sections attempt to follow is a cultivated crop like corn or tobacco one year, a small-grain crop, usually wheat or rye, one year, followed by meadow and pasture one, two, or more years.

Where crop rotations are attempted, red clover is the leguminous crop usually depended upon for forage and for keeping up fertility. In most cases it is grown with a grass crop, usually timothy, red-top, or orchard grass. Often the grasses are sown as a mixture, which furnishes hay for a year or two after the clover has disappeared, and then pasture a year or two longer, after which the land is put into some cultivated crop, such as corn, tobacco, Irish potatoes, or cotton. The crop most generally cultivated, however, is corn.

The meadow and pasture crops are the main reliance for building up fertility. Red clover, through its power to take free nitrogen from the air and deposit it in the soil, replaces much of this important plant food taken out by other crops. The mass of grass roots which develop in the soil, and the clover, grasses, and weeds not eaten by animals, furnish the matter which, when rotted down, supplies humus. In addition, some benefit is derived from the manure of animals pasturing on these fields.

Clover and grasses, however, upon which these farmers depend almost wholly for maintaining crop yields, frequently fail to make a stand, especially when sown in the usual way, with wheat or other small grain as a nurse crop. The common practice is to sow grass seed with the small grain in the fall and clover in the early spring, when the ground is alternately freezing and thawing, a condition which causes a large part of the seed to be covered, while at the same time it often results in heaving out much of the grass which at this time is insecurely rooted. The small grain, having made a good start in the fall, grows rapidly in the spring and matures dur-

ing the middle and latter part of June. If during this period dry weather occurs, as is often the case, the clover and grasses are badly injured if not entirely destroyed. In some parts of the region clover is destroyed by a disease which attacks the leaves and stems. This disease has been especially disastrous to clover in Tennessee. In the second year clover is frequently heaved out of the ground by freezing and thawing in the spring.

When a good stand of clover and grasses is secured, the farmer often yields to the temptation to let it stay in meadow or pasture as long as it seems profitable, at the same time allowing other fields to remain in grain, cotton, or tobacco two or more years in succession. Under such practices the soil gradually becomes more and more unproductive, thus ultimately making it almost impossible to get a stand of either clover or grasses.

Where bluegrass is especially adapted to the soil the land has not suffered so much from this practice of successive cropping, although even in these areas, especially the hillier parts, much land has been abandoned as a result of practices leading to soil exhaustion.

Bluegrass is regarded as a more or less permanent crop. On very hilly or mountainous lands of this type such pastures are usually permanent. The less broken bluegrass lands, however, are generally cropped at intervals of 5 to 20 years.

Both tobacco and corn do especially well after bluegrass. Growing bluegrass is an economical and effective way of restoring fertility if the soil is not too much depleted, and there is no better way known to keep the soil from washing away than to have it covered with a good stand of this grass.

Generally speaking, however, the farm practices in bluegrass areas, in so far as they relate to field crops, are not essentially different from those found in other favorably-situated agricultural areas. There is the same general rotation of corn or some other cultivated crop, followed by wheat, rye, oats, or barley, which in turn are followed by red clover and grasses for meadow or pasture. Before the land is too much run down the bluegrass farmer may sow bluegrass seed with other grasses and clover and expect a good pasture sod in a few years, in this way making profitable use of the land while it is being "rested."

Mountain farming has a relationship to bluegrass farming, in that the bluegrass farmer depends to a great extent upon the mountain farmer for stock cattle to graze on his pastures. While the larger portion of the mountain lands are not well adapted to any pasture grasses yet tried, each farm carries a few head of cattle, so that each year one or more head of young stock is sold. It is also a common practice in some localities in the lowlands to buy mountain ewes for

breeding, and to consume rough feeds, such as corn stover and straw, and to graze winter-grain fields.

While, speaking generally, the lowland farms are fairly well stocked, much of the manure produced is allowed to waste. Investigations on about 100 farms in a typical general farming section of that region showed that only about 30 per cent of the manure produced on the farms was effectively used on the land. While straw is usually fed to animals or used as bedding, it is sometimes burned.

Such refuse materials as corn stalks, stubble, dry weeds, and grasses are frequently burned instead of being turned back into the soil. All of these materials contain a considerable amount of nitrogen, phosphorus, and potash, three of the most essential plant foods. The practice of "barring off" corn rows and the deep cultivation of all intertilled crops is still common, and the bad effects are frequently noticeable. Under certain unusual conditions these practices may be justifiable, but carried on year after year without any reference to soil conditions they are injurious, in the judgment of the more successful farmers.

As a rule, corn is cut and shocked. The heavy, tough stalks left after feeding are used as bedding, or, when the animals are fed in pasture, as is frequently done, these are left to fertilize the land. On certain farms it is the usual practice to "pull" the fodder—that is, strip the blades and cut off the tops of the stalks and tie them in bundles. Usually the corn in this case is husked in the field and the stalks left standing, to be cut or broken down and then turned under. Occasionally, however, the stalks are raked and burned, as a rule an unjustifiable and wasteful practice.

AGENCIES THAT HAVE PROVED SUCCESSFUL.

The things which farmers have found to be particularly effective in increasing and maintaining crop yields are fertilizers, lime, live stock, use of by-products to plow under, legumes, and grasses.

It is difficult to say which one of these agencies is most important, since the same factor can not be emphasized for all farms. An essential basis of fertility of all soils in the region is, however, a plentiful supply of vegetable matter or humus in the soil. Commercial fertilizers, the most direct sources of plant food, generally are most effective when this material is adequate. Lime, too, is most effective in soils plentifully supplied with humus. This is why stable manure, when properly handled, is the most effective material that can be used to maintain soil fertility, since it supplies not only phosphorus, nitrogen, and potash, but humus as well. Few farms in this region, however, can be managed so as to keep up fertility entirely by the use of stable manure, although it is possible greatly to increase its effectiveness on most farms.

FERTILIZERS AND LIME.

All the soils of this region are deficient in one or more of the important elements of plant food. Good bluegrass soils, as a rule, are deficient in nitrogen only, which may be supplied by growing legumes. The other soils to a greater or less extent are lacking in both nitrogen and phosphorus. All soils are pretty well supplied with potash, which may be made available from the action of decaying vegetable matter in the soil and by the action of lime and tillage practices. When starting to build up the soils, however, it is often advisable to use a small amount of potash in addition to phosphorus. All soils are benefited more or less by lime, though the bluegrass soils are least in need of it.

Except under special conditions, nitrogen need not be purchased in the form of commercial fertilizer. By the use of stable manure and general by-products, such as straw and other wastes from feeding, in addition to turning under legumes, the supply of nitrogen may be kept up. In case a meadow, on account of dry weather or too many cuttings, refuses to start off well in the spring, a top dressing of nitrate of soda will generally give it a start and greatly increase the yield. Corn also may occasionally be profitably benefited by a light application of nitrate of soda or other material from which nitrogen is directly available.

Phosphorus is most generally obtained and used in the form of acid phosphate, but the ground rock phosphate without acid treatment is sometimes used. This material is not generally effective except when applied to land that previously has been supplied with manure or other decaying vegetable matter. In the present condition of most of these run-down soils which are greatly lacking in phosphorus, farmers as a rule will not be able to get quick and satisfactory results from its use. Even acid phosphate is much more effective when used on land with a plentiful supply of humus.

While lime benefits directly nearly all crops commonly grown in this section, its most beneficial effects are shown on clover, causing a better stand and a more vigorous growth. Generally speaking, when the farmer has solved the problem of procuring a good stand and vigorous growth of clover he possesses the key to successful farming.

LIVE STOCK.

The study of a year's business of about 600 farms in different localities of this area showed that live stock was one of the important factors in increasing the yield of crops. Live stock is not an absolutely essential factor in building up the soil or in maintaining its fertility, since plant foods can be supplied in other practical ways;

but for most farms in this region live stock must continue to be depended on to a large extent for increasing yields and for maintaining them.

Live stock affects yields in two ways, namely, by the manure produced and left on the farm and by the increased acreages of grass and legumes used for grazing and hay. Grass keeps the soil from washing away, and where turned for a crop its numerous roots provide the decaying vegetable matter so essential to soil fertility. The legumes supply nitrogen as well as vegetable matter.

Grain and forage take out of the soil a large amount of plant food, and when these are fed the greater part of this plant food is retained in the manure, which, when properly cared for, may be largely returned to the soil.

BY-PRODUCTS AND WASTES.

Straw and stalks.—The most practical way of putting straw and cornstalks back into the soil is to feed them to animals or use them as bedding. Tobacco stalks should be hauled back and scattered on the land. It is a practice of some good farmers to feed corn from the shock on the poorer places in pastures. In this way manure is economically applied to places most in need of it. These places are often at the same time reseeded to grasses and clover, depending on the cattle or sheep to tramp in the seed. Some farmers regard it an excellent practice to scatter straw over land sown to clover. It is found that the stand is usually greatly improved by this means. Occasionally farmers in western Kentucky and Tennessee, like the majority of farmers in the corn belt, husk the standing corn in the field and, after pasturing the stalks with cattle or sheep, plow under the remainder not eaten by these animals. On some types of farm this may be the most economical practice.

Weeds, stubble, and leaves.—Such refuse material as dry grass, weeds, and stubble are often considered merely as a nuisance and for this reason are frequently burned to get rid of them. As a matter of fact, on most farms they may be turned to a very useful purpose. Leaves of trees, for instance, contain about the same percentage of the important plant foods as straw and corn stover. The most practical way to utilize these for soil improvement, is as bedding for animals. Many successful farmers have demonstrated the value of these materials, and will rarely burn them or otherwise allow them to be wasted. Instead they are returned to the soil. Farm refuse may also serve a useful purpose of reclaiming gullied land and in preventing further erosion. One of the common and most practical ways to fill up a gully is to construct out of planks, poles, or stone low dams at intervals of 30 to 50 feet, depending upon the slope; behind these straw, branches of trees, leaves, weeds, etc., may be

thrown. Figure 6 illustrates how farmers often reclaim gullied land simply by the use of brush. Sometimes, in order to keep the soil from being carried off the farm and leaving deep gullies, it is practicable to build a more permanent dam out of stone at the foot of a low depression. The soil washed from the slopes of the fields will gradually be deposited behind this wall and ultimately partly fill up the depression (see fig. 7).

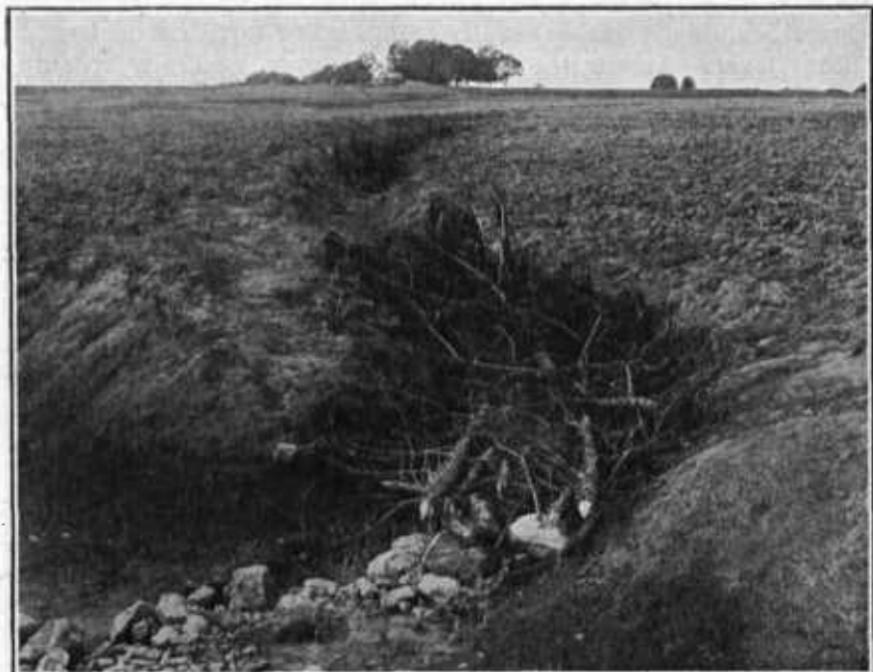


FIG. 6.—A common method of checking erosion and filling up a gully. Small trees and branches are thrown into the gully to hinder the flow of surface water during heavy rains, thus causing the earth carried down by the water to settle around and above the pile of brush. By this method it is possible to fill up a gully of ordinary depth almost completely in a short time. When once filled in, the place should be kept in grass to prevent further washing. Deep plowing and winter cover crops will tend to hold the new soil when the land is being used for grain crops.

LEGUMES.

The growing of legumes is one of the most important factors in good farming in this region. Besides being grown in regular rotation with other field crops, the favorable climatic conditions allow many kinds to be used as catch crops for soil improvement as well as for forage and seed. Legumes are the cheapest and most practical sources of nitrogen supply for the large majority of farms. Hence, a practical knowledge of their characteristics and uses is of the greatest importance.

The important point to keep in mind about all legumes is that they thrive on nitrogen absorbed from the air by organisms living in

tuberles on their roots, and passed into the body of the plant as it matures. When the legume is plowed under while green, practically all of its nitrogen is available for soil improvement. When the legume is cut green for hay a part of the nitrogen may be left in the soil, but when allowed to mature and then removed little nitrogen remains to benefit succeeding crops. When growing a legume on a piece of land for the first time it is usually necessary to inoculate it with soil where it has grown before, or by special preparations which are obtainable usually from seed or fertilizer dealers.

Red clover.—Among the legumes, red clover, generally speaking, is the most important crop grown in this region. Land that will



FIG. 7.—The stones scattered over this field were picked up during slack work periods and laid up across a gully as a means of filling it up and preventing further waste of the soil.

grow red clover without much difficulty may usually be depended on to produce good yields of all general crops. The vigor of its stand and growth is the best test that can be made of the quality of the soil. When it fails to make a stand farm plans are thrown out of balance, and this condition usually marks the starting point of serious soil deterioration. The one great aim in general farming should be, then, to keep the soil in shape to grow vigorous stands of red clover. If the crop is liable to miss or make a poor stand every few years, measures should be taken to improve the soil. The first and most important step in doing this is to use lime. Red clover requires also a plentiful supply of decaying vegetable matter.

Alsike clover.—Many progressive farmers are sowing a mixture of red clover and alsike clover. Alsike is better adapted to wet soils than red clover, and is not so easily heaved out of the ground by

freezing and thawing. Alsike will usually hold to the soil longer than red clover, and for this reason it is especially valuable for pasture.

Japan clover.—Japan clover (*lespedeza*) is rapidly coming to be a very important legume for soil building and improvement. It is used with good effect in a mixture with red and alsike clover, some farmers having thus used it with marked success. Japan clover is not nearly so sensitive to "sour" soils as is red clover. While it grows most vigorously on well limed and fertile soils, it will make a fair stand on poor, thin soils, where red or alsike clover will not take hold. By taking hold of poor soils in this way it is a plant well adapted for the beginning of soil building. This clover is an annual, reseeding itself late in the season each year, if given a chance. For many years, in the more southern portions of this region, it has grown in waste places along roadsides and has gradually found its way into old pastures. Only in recent years, however, has its value as a soil-building, pasture, and forage crop come to be fully recognized. On the Cumberland Plateau in southern Kentucky and in Tennessee it grows quite generally in the more open places with native grasses and for many years has been depended on for general grazing.

Sweet clover.—Sweet clover is found here and there in waste places over much of this region, wherever the soil is plentifully supplied with lime. It is especially adapted to soils containing lime, but which are deficient in organic matter and nitrogen. As a practical soil builder and forage crop it has not proved generally as successful here as in other places. In a few places, however, it has been used with marked success in reclaiming practically waste land and making it productive. The most notable success along this line has been achieved in the northern part of the Bluegrass region of Kentucky, where hilly farms had become depleted in soil fertility and badly gullied.

Crimson clover.—Crimson clover is best adapted to light sandy soils and to soils plentifully supplied with decaying vegetable matter. Generally it has not been successful when sown on heavy clay soils. Like Japan clover, it is better adapted to acid soils than are the other clovers. It has been grown with success on mountain lands, these usually being of a looser and more porous texture than limestone soils. In some places crimson clover is sown between rows of cultivated crops such as corn, tobacco, cotton, soy beans, or potatoes. As a rule, however, it is not advisable to sow it in this way unless the soil is plentifully supplied with vegetable matter and is moist.

Vetch.—Like crimson clover, vetch is best adapted to light sandy soils, but even on loose, loamy clay soils, if they are fairly rich, it will grow very well when properly seeded. It is a climbing plant

and does best when supported by such a crop as rye, wheat, oats, or barley. It usually also improves the growth of these crops through its ability to gather nitrogen and store it in the soil. Rye and vetch mature at about the same time; so that together they may be turned under for green manure or cut for hay or for seed. A most important point in beginning to grow vetch is that the soil should be thoroughly inoculated with the proper bacteria. Probably more failures to get a start in growing it have been due to lack of proper inoculation than to any other cause. Sown with rye in the fall vetch makes an excellent winter cover crop, and its quick early growth in the spring makes it an excellent and practical soil improver, since it can be turned under early enough for the planting of cultivated crops such as corn, tobacco, or potatoes. It has been successfully used in building up some of the poorest soils in this region.

Cowpeas.—Cowpeas are also well adapted for soil improvement in this region. With a little stimulation by means of commercial fertilizer they will grow and make a fair crop on the poorest land. For this reason they are a good crop to begin with in the process of building up poor soils. Cowpeas may succeed any small-grain crop in this region as a catch crop, and are a valuable crop to succeed small grain in which the clover sown has been killed out. Cowpeas are frequently planted with corn. Where grown regularly in a rotation it is the best practice to follow them with wheat, barley, rye, or oats.

Soy beans.—Soy beans serve about the same purpose in soil improvement as cowpeas. They are more valuable, however, as a money crop, since they produce more seed. For this reason they are finding greater favor among farmers in many sections than are cowpeas. The period of growth is a little longer than for cowpeas. Farmers frequently plant soy beans with corn, either in the same row or in alternate rows. The planting of corn and soy beans in this way is an excellent practice when the field is to be hogged off, since it not only saves labor in harvesting, but the parts of these plants not eaten are left on the ground to be turned under. Soy beans, like cowpeas, are an important crop in rotations common in this region, and when so used should precede small grain. Figure 8 shows a crop of soy beans which have been cut for seed.

Canadian field peas.—In its nature and habits of growth the Canadian field pea is very much like the ordinary garden pea. It is one of the earliest crops that may be planted in the spring. In parts of this region it may be planted as early as the latter part of February or 1st of March. Field peas may be planted with spring oats or alone on specially prepared land. Canadian field peas grow best on a rather light, loose, or sandy soil, and in a cool, moist climate. For this reason they are best adapted to the high plateau or high mountain farms.

GRASSES.

One of the most important agencies depended on by farmers to improve the soil and maintain crop yields is grasses. On good land grasses fill the soil to a considerable depth with roots, thus forming a tough sod, which when turned under leaves a good supply of decaying vegetable matter in the soil. Run-down land kept in grass a few years and pastured largely regains its lost fertility. Grass is also a valuable agency for preventing soil erosion. The following grasses have become established where conditions favor their growth.

Bluegrass.—For limited areas, such as have already been pointed out, bluegrass stands first among the grasses as a soil improver. It



FIG. 8.—Soy beans in the shock. The soil is left in excellent condition for wheat or other winter grain crop. (Photo loaned by Kentucky Experiment Station.)

is also an effective means of holding the soil in place. Rough, hilly, bluegrass lands are now quite generally sought after and bring high prices because of their value for grazing purposes. On soils rich in lime and phosphorus it usually comes in and occupies the land, crowding out all other plants. However, in order to get a heavy and quick stand, even on soils adapted to it, seed should be sown.

Redtop.—Redtop probably has a wider distribution than any of the other grasses grown in this region. This grass seems to be fairly well adapted to all classes of soils. It is depended on mostly for pasture on mountain lands and the poorer limestone and shale soils.

It is, besides, better adapted than other grasses to poorly drained soils. It fits well into the usual rotations and is commonly grown in a mixture with orchard grass and clover.

Timothy.—Timothy is grown in all parts of the region, but not as extensively as redtop. It requires a fairly rich and well-drained soil and is better adapted to the moister and cooler climates. When grown it is usually sown in a mixture with other grasses.

Orchard grass.—Next to redtop, orchard grass is the most widely grown. On fertile soils orchard grass, like bluegrass, will grow fairly well in shaded places under trees. In such places it will do well on certain types of soil not adapted to bluegrass. It has the habit of growing in rather dense bunches, leaving uncovered spaces between. For this reason it is not as well adapted as bluegrass or redtop for holding the soil. By sowing it in a mixture with other grasses, however, this difficulty is largely overcome. In a few places—for instance, in northern and southwestern Kentucky—orchard grass is grown quite extensively for seed. When grown for this purpose the seed bed is specially prepared and the seed sown either in the fall or early spring. Ordinarily it is sown with a nurse crop, such as wheat, rye, oats, or barley. Usually it is cut a year or two for seed, pastured at intervals, then used for meadow or pasture, and finally the sod is turned and followed by some cultivated crop, like corn, tobacco, or potatoes.

Tall oat grass.—This grass has done well in many parts of this region and is well adapted to most soils that are in a fairly good state of fertility. It has good capacity for hay production and is an excellent pasture grass. It may be sown with a nurse crop, such as wheat, barley, oats, or rye. It may also be sown alone or in a mixture with legumes and other grasses early in the fall or early spring on land specially prepared. It may be cut early in the spring for hay, and frequently a later crop may be harvested.

Rye.—No crop is more generally used, or is more effective as a cover or green manure crop, than rye. On the thinner lands rye is the last small-grain crop to be given up on account of the land being poor. In mountain farming it is about the only small grain raised. It is also extensively raised in the more fertile areas for pasture, for winter cover crop, and for turning under as green manure. In the rich farming section near Louisville, Ky., where Irish potatoes are extensively grown, it is a common practice to turn under a crop of rye early in June to precede a late crop of potatoes, which are planted early in July. It is generally believed that the vegetable matter thus put into the soil and allowed to decay conserves moisture and aids in making plant food available.

ROTATIONS.

The practice of rotating crops is one of the means of keeping the soil in proper condition and of increasing and maintaining yields. Each crop has its own peculiar root system and its own special way of getting food from the soil. For this reason and others previously mentioned, it is found in general practice that crops do better by being shifted frequently to different fields. Crops grown on land which overflows each year, or on land receiving special treatment by manures and tillage practices, as is done in gardening, may do well on the same land indefinitely, but for the general farmer the practice of rotating crops seems to be essential in maintaining good crop yields.

The rotations described in the following pages are being followed with more or less regularity by a good many farmers. Quite generally these rotations have given satisfactory results where the location, the type of farming, and the soil conditions have been given proper consideration. They quite agree in the main with those recommended by experiment stations in the States included in this region. The Tennessee Experiment Station, in particular, has worked out in detail several crop rotations which apply to special regions of the State and which have proved successful on many farms. (See Bullets 101, 102, and 109, Tennessee Experiment Station, Knoxville, Tenn.)

It is recognized that no fixed rotations can be followed with strict regularity, but a careful study of farming in this region shows clearly that a rational crop rotation, followed with as much regularity as conditions will allow, is the basic factor in maintaining and increasing crop yields.

A FIVE-YEAR ROTATION FOR GENERAL FARMING.

First year.—Soy beans or cowpeas.

Second year.—Wheat or other fall grain crop, with clover and grass.

Third year.—Clover and grass.

Fourth year.—Clover and grass.

Fifth year.—Corn, followed by rye for winter cover crop. (Tobacco, where it is grown, may be substituted in part for corn.)

This rotation has given good results on many farms and can be quite generally recommended. It is well adapted for building up the soil, especially if the farm is kept stocked to full capacity.

It will be noticed that a rotation such as this provides a winter cover crop for every field. This is an especially desirable feature anywhere in this region, since the heavy rains that come during the winter and spring months wash away much of the soil unless held by meadows, pastures, or cover crops. In some cases, however, it is fre-

quently advisable to turn the grass sod in the fall for corn, when it will be exposed to winter, fall, and early spring rains. Well-sodded land turned thus in the fall will seldom be injured on account of erosion.

In order to increase the chance of a good stand of clover and stimulate its growth the land to be planted to wheat should be limed.

The best time to apply the lime is before sowing small grain in the fall, or, in case corn is to be followed by small grain, the lime should be applied just before the corn is planted. In this way the corn will also be benefited.



FIG. 9.—A field of Burley tobacco ready to cut and house. Tobacco is the most important cash crop in the middle and western portions of Kentucky and Tennessee. It is a profitable intensive crop, fitting into rotations just as corn or potatoes. By growing tobacco the bluegrass farmer may profitably keep a large part of his farm in bluegrass for grazing and to prevent the soil from washing. (Photo loaned by Kentucky Experiment Station.)

It is usually advisable to sow a mixture of clovers as well as a mixture of grasses. Some farmers are using alsike and Japan clover with the red clover. Those who have tried this mixture have found it very profitable. Alsike, while in many respects not as desirable as red clover, is not subject to the clover disease so common in a large part of this territory. It is also adapted to certain soils on which red clover is not so liable to grow. Japan clover will frequently grow on land where neither red nor alsike clover will grow, and for this reason, as well as others, it may be a valuable part of the clover mixture. With such a mixture a farmer is practically certain to have his entire field covered with some kind of clover, no matter what the conditions may be.

A good grass mixture in this rotation is redtop, orchard grass, timothy, and tall meadow oat grass. If the land is to be pastured, meadow fescue and white clover might profitably be added to the mixture. Bluegrass is sometimes added also for pasture purposes. While meadow fescue and white clover are fairly well adapted to most good soils, bluegrass will not do well unless the soil is specially rich in phosphorus and lime.

In following such a practice as this there should be little danger of a break in the rotation on account of a failure of clovers and grasses. Such a practice would also increase greatly the carrying capacity of the land for live stock, which would further tend to increase and maintain yields. A careful study of general farming in the region has shown that in order to maintain crop yields and profitably run a farm, it should carry not less than the equivalent of a cow or beef animal to every 5 or 6 acres of crops, including meadow and pasture. Good average pasture should carry one such animal to not more than 3 to 4 acres six to seven months of the year.

This rotation, as outlined, can be varied in a number of ways to suit general local conditions or the special conditions of any particular year. For instance, in places where cotton is grown this crop could take the place of clover and grass in the fifth year. This, however, might reduce the amount of live stock that could be kept, and to compensate for this factor in maintaining fertility it might be necessary to plow under the legume crop in the second year, although this may be avoided in some cases if crimson clover could be sown at the last cultivation of cotton. In place of crimson clover some farmers might find it preferable to sow vetch and rye to turn under for corn.

In places where Irish potatoes do well they could be handled in this rotation in the place of cotton.

A FOUR-YEAR ROTATION ESPECIALLY ADAPTED FOR MOUNTAIN LANDS.

First year.—Corn followed by rye for cover crop.

Second year.—Sorghum and cowpeas sown broadcast.

Third year.—Clover and grass.

Fourth year.—Clover and grass.

In this rotation millet might be substituted for sorghum and peas in the second year, or, in place of these, spring oats and Canadian field peas may be substituted and followed the same season by buckwheat, with which clovers and grasses could be sown. Spring oats and buckwheat do especially well in the higher altitudes where the summer rainfall is heavy. Irish potatoes, a crop well adapted to the high plateaus, may take the place of corn or a part of it in this rota-

tion. All the crops suggested for this rotation have been grown with success by several farmers on the high plateaus in the Allegheny Mountains.

A COMMON THREE-YEAR ROTATION.

First year.—Corn.

Second year.—Wheat or some other fall grain.

Third year.—Clover or clover and grass.

This is a common rotation which has been successfully followed by many farmers in all parts of this region. It is a good one to follow when there is enough permanent pasture on the farm to support the live stock, which should properly be carried without much rotation pasture. Such a rotation combined with the proper handling of manure and waste should rapidly build up the soil and increase crop yields.

When it is desirable this may be changed into a four-year rotation in any one of three ways: First, there may be two crops of corn on the same field in succession, the other crops following in the same order. Second, two crops of wheat may be raised in succession instead of two crops of corn in succession. In this case the clover and grasses will be sown with the second crop of wheat. Where this is done, after the first crop of wheat is off the land is summer fallowed, after which it is sown again to wheat and grass with clover or clover mixtures in the spring. Third, a pasture crop may succeed a meadow crop. In case this is done, it is advisable to add pasture grasses to the clover. All these different variations suggested are successfully practiced by farmers in various places.

The practice of following corn with corn in a four-year rotation is most usually found on cattle-feeding farms. It is a common rotation on cattle and hog farms in the corn belt. The cattle are usually bought off the farm, pastured a while in the fall on clover, and afterwards put on a full ration of corn. This allows a considerable amount of clover to be turned under to supply nitrogen and vegetable matter. In such a system the small grain and tobacco, when raised, are practically the only crops sold.

SOME EXAMPLES ILLUSTRATING GOOD FARM PRACTICE.

A SUCCESSFUL LIVE-STOCK AND GRAIN FARM.

This farm consists of about 300 acres, partly rolling and partly mountainous land. The rolling land is mostly limestone, the rest being limestone for about halfway up the mountain and sandstone the rest of the way. About 190 acres are in crops and the remainder in permanent pasture. The limestone part of the pasture supports a good stand of bluegrass and white clover, while the sandstone and shale soils grow redtop and orchard grass with some white clover.

The usual crop rotation is as follows:

First year.—Corn, with rye as a cover crop.

Second year.—Cowpeas; sometimes soy beans.

Third year.—Wheat.

Fourth year.—Red and alsike clover and mixed grasses.

Fifth year.—Clover and grasses.

Dairy cows, stock cattle, hogs, and a few sheep are the animals usually kept on this farm. Wheat and some hay are sold. All other crops are usually fed.

The farm is well stocked, mainly with dairy cows, beef cattle, hogs, and sheep. The total number usually kept is equivalent to about 60 head of beef cattle.

Several years ago the burning of lime was begun on the place and the entire farm has now been limed.

Corn has yielded as high as 75 bushels per acre; wheat, 35; and hay, $1\frac{1}{2}$ to 2 tons per acre. It is estimated that the average yield on this farm since it has been brought up to a good state of fertility is 50 bushels of corn, 25 bushels of wheat, and about $1\frac{3}{4}$ tons of hay per acre. This is about 100 per cent better than the average yields for the community.

Some valuable experience was gained on this farm in the matter of growing grasses and clover and in the control of erosion. There is very little level land on the farm. Even the land adapted to tillage is quite steep in places, and special precautions must be taken to keep the soil from washing away. During the past 10 years there has been an attempt to get the steeper lands into permanent pasture and at the same time preserve some of the forest. Some of this steep land is well adapted to bluegrass. Elsewhere orchard grass or red-top is grown. On the side of a very steep hill, where the soil is of mixed origin, derived in various proportions from shale, sandstone, and limestone, black locusts have been planted and orchard grass sown on the land among the trees. Stimulated occasionally with small applications of bone meal, the grass has kept up a vigorous growth and furnishes excellent pasture for stock. Gradually the pasture area is being pushed up the mountain side with such grasses as will take hold. The locust trees help greatly in holding the soil in place on the steeper slopes.

No field on the farm is left bare during the winter. The heavy rains here during this time of the year and early spring would almost ruin the rolling limestone lands if they were left bare.

BUILDING UP AN ABANDONED FARM.

A farm of about 200 acres is located just at the foot of mountains and adjoins a rolling bluegrass area. There is no bluegrass here, however. The soil is derived largely from black shale. Some of

the more level parts of the farm, known as glade land, are almost black in color.

This farm was practically abandoned many years ago as being worn out. Some parts of it had grown up in small scrubby timber. Other parts seemed to be too poor to grow any kind of vegetation except scattered bunches of native grass here and there.

About eight years ago a start was made to build up the soil and reclaim the farm and a remarkable success has been achieved. Crop yields have more than doubled during the period and from the beginning the farm has earned profits. It is now one of the most productive farms in the State.

The special crops used for soil building were rye, vetch, cowpeas, alsike, and red clover. Tall meadow oat-grass, perennial rye-grass, and orchard grass were also important factors in this soil building. The principal grain crops were corn and wheat. Considerable rye and vetch seed were also produced and sold. The live stock were mainly dairy cows and hogs.

The general plan followed in improving the soil on this farm and making it more productive may be explained by giving the history of three fields which are typical of other parts of the farm.

In the fall of 1906 field No. 1 was plowed up and seeded to rye and vetch. The vetch was thoroughly inoculated with a culture obtained from a seed and fertilizer dealer. About 200 pounds of 14 per cent acid phosphate and 40 pounds of muriate of potash were used for fertilizing each acre planted. This crop was pastured in the fall and spring. In the latter part of June the following year the remaining crop was turned under and cowpeas planted. These were cut for hay in the fall. The field was then disked and sown again to rye and vetch. Tall meadow oat-grass, perennial rye-grass, redtop, and meadow fescue were sown with the rye and vetch in the fall, red and alsike clover being sown on the field in the early spring. When rye and vetch were sown in the fall about the same amount of fertilizers was used as in the first year. The rye and vetch were cut early the next spring for hay, and two successive hay crops were harvested the same year. This hay was composed largely of tall meadow oat-grass and perennial rye-grass. The next year two crops of hay were cut, so that in all during the two years the field had produced about 5 tons of hay per acre.

In the spring of 1909 this field was plowed up and planted to corn, which yielded about 65 bushels per acre. During the next few years the usual rotation was rye and vetch, clover and mixed grasses, followed by corn. Occasionally a cowpea or soy-bean crop was put in as a catch crop.

Field No. 2 was more difficult to handle than field No. 1. Very little vegetation had grown on it for many years. The same kind

of soil on an adjoining field had been used for making brick. In the spring of 1907 this field was plowed up and planted to cowpeas, after being fertilized with the usual amount of acid phosphate and muriate of potash. The peas were turned under in the early fall, and after the ground was thoroughly cultivated and packed by frequent disk ing and harrowing, winter oats and vetch were sown late in August. The field was thoroughly inoculated with soil from field No. 1, about 8 bushels per acre being used.

This field furnished pasture for sheep, hogs, and calves in the fall. The next spring it was pastured until June. The land was turned and planted to cowpeas, which were cut for hay about September 1. The peas made about 2 tons per acre. The land was then plowed and sown to rye, vetch, and mixed grasses. This mixture was the same as used on field No. 1. Vetch and rye were cut for seed in July, making 17 bushels per acre. Following this during the same year $1\frac{1}{2}$ tons of hay were cut and then pastured with calves three months in the fall. This field since has had about the same history as field No. 1.

Field No. 3 was a northern hillside slope, the soil being derived wholly from black shale $2\frac{1}{2}$ to 3 feet deep. In 1907-8 this field received a generous supply of stable manure and produced a fair corn crop, about 45 bushels per acre. In the fall it was put into rye and vetch with mixed grasses, red and alsike clover being sown in the early spring. The soil was thoroughly inoculated for vetch, and the usual amount of fertilizers, acid phosphate and potash, were used. Figure 10 is a photograph of this field as it appeared in June, 1909, after it had been planted in rye and vetch. Figure 11 shows an adjoining field sown to rye alone in the usual way the same year. This field had received no manure or commercial fertilizer.

It should be stated that the operator of this farm was an exceptionally skillful and experienced farmer. He was able to command sufficient capital to carry out his plans and had plenty of labor available. Success was also due in large part to his careful personal attention to the carrying out of his plans. The plowing, disk ing, harrowing, and rolling, when needed, were done carefully and with reference to the season and the needs of the soil.

Farmers have not usually had good success with hairy vetch, which seems to have been an important agency in the improvement of this farm. Neither have tall oat-grass and perennial rye-grass been widely and successfully grown in the region. However, on this farm and on other farms in near-by States this farmer has demonstrated the value of hairy vetch and these grasses in the profitable management of farms.

A RUN-DOWN FARM MADE PRODUCTIVE.

The farm here described is situated in a more or less mountainous section of Kentucky, where the soils are derived mainly from limestone and shales. On the whole, they are classed among the poorer soils of the State. The owner has lived on the place about 25 years. When he first came agriculture was not the main occupation of most farmers. They were largely engaged in lumbering, an extensive business at that time. Corn and wheat were raised on small patches of cleared land here and there, usually being planted alternately on the same piece of ground until it would no longer pay for labor, and so was abandoned to "rest" while another patch was cleared off on

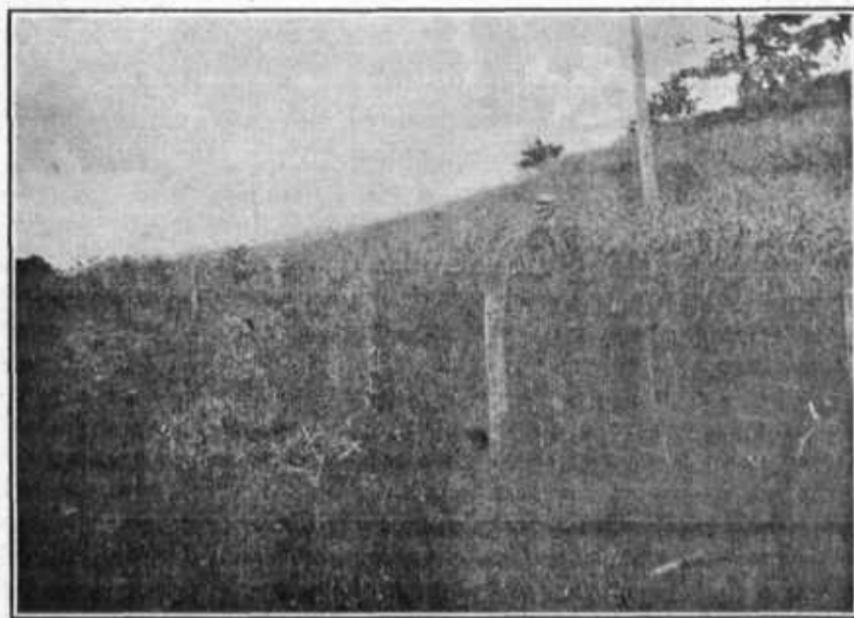


FIG. 10.—A run-down piece of shale land being "built up" by rye and vetch. This crop was planted after a corn crop.

which the same practice followed. Two to six bushels of wheat per acre and 10 to 15 bushels of corn were common yields.

This farmer, however, began by devoting his entire attention to farming. His first crop of wheat, stimulated with a small application of commercial fertilizer, made 12 bushels per acre. The farm in later years has produced as much as 27 bushels of wheat per acre and 70 bushels of corn.

A four-year rotation was early adopted, the usual crops being corn, rye, oats, or wheat, and two years of clover or mixed grasses for meadow and pasture. The clover mixture has usually been red and alsike clover. The grasses used have been mainly redtop and timothy. Cowpeas, soy beans, crimson clover, and vetch have all

been grown with success. Alfalfa has been tried, but not successfully established. These various soil-building legumes have occasionally been put into the rotation; but in the main they have been used as catch crops or have been put in with corn or other cultivated crops.

This farm is well stocked. A few good dairy cows are kept and a special trade in butter has been built up in a near-by town. A few hogs and cattle are sold each year, as well as some poultry and poultry products.

One of the big factors in the improvement of this farm has been the care in handling manure and in utilizing every possible waste



FIG. 11.—A field adjoining that shown in figure 10. This land had received no treatment. Rye sown without fertilizer.

product to furnish organic matter for the soil. Acid phosphate and some potash are regularly used on wheat and corn. Manure is usually spread on pasture land before plowing it up for corn. Up to a few years ago no lime had been used. However, the soils in this section are usually greatly benefited by lime, and undoubtedly the yields on this farm could be greatly increased by its use.

The somewhat unusual practice of mowing down weeds in stubble fields as well as in pastures has been regularly followed on this farm. Whenever there is opportunity and the fields need it, the team and mower are used to clip weeds. As a result the farm is kept unusually free of weeds, and there is little doubt that considerable moisture is

saved for the growth of the useful plants by this practice. By mowing the stubble after wheat is cut in June, the clover and grasses are well protected from the effects of droughts, which frequently occur.

Much more than ordinary attention is given to the preparation of seed beds. In fact, the uncommonly high and uniform yields obtained are due very largely to care in this matter. Wheat usually follows corn, but here there is sufficient time, as a rule, to disk and harrow the field after corn is cut and before it is time to sow wheat. This practice destroys the weeds, which find an opportunity to grow vigorously at this time, thus conserving moisture for the wheat and grasses to be sown later.

The same careful attention is given to the preparation of seed bed for the corn crop following pasture. The sod is usually turned in the fall after scattering manure. In the spring, before planting, the disk and harrow are run over the ground as often as time permits. Harrowing is continued after the corn is up until it is several inches high. The common practice of deep cultivating and "barring off" was discontinued many years ago. After the thorough harrowing given before and after the corn is planted, generally but two or, at most, three cultivations are needed to keep the corn perfectly clean. The corn is usually "laid by" with a small-tooth cultivator, having practically the same effect as a harrow. In the spring, after clover has been sown on the wheat, the ground is sometimes rolled in order to cover the clover seed and pack the soil about the roots of wheat and grasses.

A PRODUCTIVE MOUNTAIN FARM.

This farm is typical of the mountain districts, the soil being derived almost wholly from sandstone. There are about 80 acres in the tract, all quite hilly, some parts being very steep. For many years the following four-year rotation has been followed, which has greatly improved the crop yields:

First year.—Corn.

Second year.—Oats or rye.

Third year.—Clover and grass for meadow.

Fourth year.—Clover and grass for pasture.

The farm is kept well stocked, mainly with cattle and hogs. Several dairy cows are kept and a few young cattle. Surrounding the farm is a well-developed coal-mining section, furnishing a local market for dairy products.

The corn yield has been increased from 15 or 30 bushels to 35 or even 45 bushels per acre, wheat from 5 or 10 bushels to 15 or 20 bushels per acre, hay from one-half or 1 ton to 1½ tons or 2 tons per acre.

Usually orchard grass and redtop are sown in a mixture with rye, or when oats follow corn as the grain crop they are sown in the spring, grasses as well as clover being sown at the same time. As a rule, al-

sike is sown with red clover in order to secure a thicker and more even stand; besides, the alsike will hold the land longer than red clover, thus increasing the value of the pasture. Usually the pastures and meadows on these mountain farms are not well sodded. The grasses usually show a thin, uneven stand, while tree shoots and broom sedge crowd in. On this farm, however, the steep, rounded hills were well sodded with a vigorous stand of grasses. These results are due to the quite regular four-year rotation followed for many years and to the care given the meadows and pastures. Pastures are not grazed too close, and the few sheep kept on the farm keep down the sprouts and weeds.

A SUCCESSFUL MOUNTAIN STOCK FARM.

This farm contains about 175 acres, the greater part of which is steep mountain land. The difference in elevation between the lower and more level land and the highest part of the farm is about 600 feet, this difference being reached within about one-half mile. With the exception of a few scattered trees on the highest part of the farm the land is cleared. There is not over 10 acres of level land. This, and about 25 acres more of hilly land, is cultivated. The soil for about halfway up the mountain is derived from a good quality of limestone, well adapted to bluegrass. For the rest of the way up the mountain the soil is derived largely from shales and sandstone. The limestone soil supports a good stand of bluegrass and white clover. The shales and sandstone soils support mainly redtop, orchard grass, meadow fescue, and some white clover.

This farm has been in the hands of the present owner about 10 years and in that time its production has about doubled. The usual rotation on the cultivated fields is:

First year.—Corn, followed by rye for winter cover crop.

Second year.—Cowpeas, followed by wheat in the fall.

Third year.—Wheat, with mixed clovers and grasses.

Fourth year.—Clovers and grasses.

Fifth year.—Clovers and grasses.

Cattle and hogs are the animals chiefly raised. Some beef cattle are finished on bluegrass pasture and some are fattened on corn silage and cottonseed meal. A considerable number of hogs are kept to follow steers fed on corn and to utilize other wastes.

During the late fall and winter cattle are fed corn fodder on the poorer spots where grass has a tendency to fail. In this way a more even stand is secured and erosion prevented. In order to induce the cattle to climb to the higher parts of the fields, watering places from springs are made high up toward the top of the mountain. This device and the trees near the top of the mountain, which furnish shade on hot summer days, help in bringing the cattle to all parts of the pasture, thus securing more even grazing.

Although this is a very steep farm, the erosion has been very slight since it has been in the hands of the present owner. This is due mainly to care in keeping all parts of the pasture land well sodded. Where the land is too steep and too poor to grow pasture grasses, the natural forest trees are left standing. However, there are very few places on the farm where the soil is too poor to support any kind of grass or legume for pasture.

The pasture carries about one steer to every 2 or 3 acres, depending on the season.

Corn usually yields about 60 bushels per acre, wheat 20 to 25 bushels, and hay $1\frac{1}{2}$ to 2 tons per acre.

Manure from the barns is applied mostly to land growing grain and meadow crops. Acid phosphate is used when sowing wheat. The land has never been limed, although some parts of the farm would undoubtedly be benefited by it.

A FARM MADE MORE PRODUCTIVE BY REPLANNING.

An interesting example of a farm made more productive and profitable by reorganization is that of one of about 1,200 acres located on level to gently rolling limestone land of only fair quality. The soil, however, is deep and holds moisture well. This farm has been in the hands of successive generations of farmers of the same family for 125 years. The main crops have been wheat, corn, tobacco, red clover, redtop, and timothy; the live stock, mainly cattle and hogs. This place was typical of most farms in this locality, in that the live stock had gradually decreased for 40 years, while at the same time the field crops—corn, wheat, and tobacco—had increased. It had been increasingly difficult during this period to get satisfactory stands of clover.

About four years ago a change in the system of farming was decided upon. A general plan for management was outlined providing for a regular rotation and more live stock. It was also decided to begin liming the land; and better equipment was installed for handling and spreading manure. The general rotation plan was as follows:

First year.—Corn and tobacco.

Second year.—Wheat, barley, and rye.

Third year.—Clovers and grasses.

Fourth year.—Clovers and grasses for pasture. (Some of the second crop clover is cut for seed.)

A legume crop is occasionally put in after corn, in which case the rotation is extended to five years. Also, legumes are frequently used as catch crops or are planted with corn and usually hogged off. The clover mixture consists generally of red, alsike, and Japan clovers. The grass mixture is usually redtop, orchard grass, and timothy. Crimson clover and vetch have been grown with success and have had a part in building up the soil.

A stone crusher was purchased, and in three years the entire farm has received an application of ground limestone at the rate of from 2 to 3 tons per acre. This has had a specially marked influence on the clovers.

On account of the better field crops and better pastures the capacity of the farm to carry live stock has been greatly increased. Formerly it would scarcely carry more than 150 to 200 mature animals equivalent to a cow or beef animal. At the present time it can carry about 250 such animals. The crop yields have gradually increased, and it is estimated that this increase has amounted to about 50 per cent.

The live stock kept on the farm since replanning it has been 75 to 100 head of cattle, 300 to 400 sheep, and 300 to 500 hogs. Hogs have been greatly increased during the last two years. This increase has been due partly to advanced price, partly to ability to control cholera, and partly to methods of fattening. About one-half the weight of hogs is now produced on pasture crops, and the hogs are usually "finished off" by hogging down corn and soy beans planted in alternate rows. All the fields on the farm are fenced hog-tight, so that they may be pastured whenever it is advisable.

Japan clover has found a place of great importance on this farm. For many years it has been common along roads, in waste places, and in old pastures. Few farmers, however, have regarded it as being of any great importance except for pasture. In recent years some farmers have sown it in clover mixture and find that it greatly increases the value of the clover crop in a rotation. On this farm it is now sown generally in a clover mixture. Sown with red clover, it will not grow vigorously until the red clover has disappeared, when, reseeding itself, it will come on and make a heavy stand. On most farms of which this one is typical, there will be many places where red or alsike clover refuses to grow on account of lack of lime and vegetable matter in the soil. Japan clover will usually make a good stand on such places, although it may not grow tall enough to be cut for hay. However, it covers otherwise bare places, provides pasture, and improves the soil. Japan clover, if not pastured too close, will push ahead of grasses and weeds, making a heavy stand for seed production late in the season. During the past two years (1916-17) Japan clover has been cut for seed on this farm.

Another practice demonstrated to be of great value on this farm is that of the use of the harrow on corn land. As a rule, in this locality, after corn land is plowed only one harrowing is given, and after planting the land is seldom harrowed more than once, after which the cultivators are used. The cultivators usually run deep even when corn is "laid by." On this farm, however, harrowing is begun before planting and continued as often as is necessary to keep the cornfield clean, even until the corn is 8 to 10 inches high. The

stand of corn is not materially injured by this practice, and usually only one or two shallow cultivations are needed after the last harrowing.

PRACTICAL SUGGESTIONS ON FARM PRACTICES.

APPLICATION OF FERTILIZER AND LIME.

When commercial fertilizers or lime are needed they should be applied as directed by the experiment stations in the State where the farm is located.

Acid phosphate is usually applied in this region at the rate of 200 to 250 pounds to the acre. Potash is seldom needed, but when used it is generally applied at the rate of 25 to 40 pounds of muriate of potash per acre. Occasionally it may be advisable to buy nitrogen. The usual form is nitrate of soda, which on meadows or general field crops should be applied at the rate of 70 to 80 pounds per acre.

Commercial fertilizer and lime are practically out of reach of a large number of farms on account of long hauling distances and bad roads. This is particularly true in regard to lime, which must be applied in larger quantities per acre than commercial fertilizers. In some such cases wood ashes may take the place of lime. About three times as much wood ashes (by weight) is usually required to give effects equivalent to burnt lime. Where lime has to be hauled any distance it is usually more economical to use the burnt lime, since it is the most concentrated form in which lime is used. The other forms commonly used are hydrated lime and finely ground limestone. Under average conditions a ton of burnt lime or two tons of ground limestone per acre are used. If the hydrated form is used, 2,500 to 3,000 pounds will give equivalent results.

Where limestone crops out on a farm it may be burnt in kilns either with wood or coal. Large farmers often find it profitable to own a stone grinder for crushing limestone to apply on the land. A community of small farmers could also profitably own one.¹

¹ Practical information regarding the use of fertilizers and lime is given in the following bulletins:

- The Principles of the Liming of Soils, Farmers' Bulletin 921, United States Department of Agriculture.
- Soils of Kentucky, Bulletin 193, Kentucky Experiment Station.
- Commercial Fertilizers, Bulletin 196, Kentucky Experiment Station.
- Teachings of the Kentucky Agricultural Experiment Station Relative to Soil Fertility, Bulletin 191, Kentucky Experiment Station.
- Rational Improvement of Cumberland Plateau Soils, Bulletin 101, Tennessee Experiment Station.
- Rational Improvement of Highland Rim Soils, Bulletin 102, Tennessee Experiment Station.
- Fertility and Crop Experiments at the West Tennessee Station, Bulletin 109, Tennessee Experiment Station.
- Fertility Experiments in a Rotation of Cowpeas and Wheat, Bulletin 96, Tennessee Experiment Station.
- Use of Lime on the Farm, North Carolina Experiment Station Circular 28.
- Liming for Tennessee Soils, Bulletin 97, Tennessee Experiment Station.
- Lime for Virginia Farms, Bulletin 187, Virginia Experiment Station.

TILLAGE PRACTICES.

Crop yields are influenced a great deal by tillage practices. The time of year when the land is plowed, the methods of preparing the seed bed, and of cultivating the crop, may each be an important factor in determining yield. It is not necessary or even advisable to follow the same order or routine of tillage practices each year. These should be varied to meet special soil conditions. For instance, if the subsoil on a piece of land has received a shallow plowing for many years, causing it to become packed, thus making soil draining difficult, deeper plowing, or even subsoiling, may be beneficial. Such soils treated in this manner, especially when well supplied with vegetable matter, can be worked much earlier in the spring and much sooner after a rain. Besides, in this condition the soil is warmer and will sprout seeds sooner and more vigorously, thus increasing the chances of good yields. Small grains, grasses, and clover crops require, for best results, a smooth, well-packed seed bed. This condition may sometimes be achieved simply by harrowing and disking. At other times, under different conditions, the roller or plank drag should be used to accomplish this result.

The main object in cultivating the soil should be to prevent the growth of weeds, which rob the crops of their proper food and moisture. In cultivating corn or tobacco, for instance, the object should be clean fields. This object could be secured with better results and with less labor if some of the more common practices were discontinued and the practices of more progressive farmers adopted.

The common practice in raising corn, for instance, is to plow the land, harrow once or twice to smooth off the surface, and plant. The corn is cultivated several times with a one-shovel or a double-shovel cultivator. Frequently the hoe has to be used also in order to keep down weeds.

The best practice is to begin cultivation by harrowing and disk-ing as soon as the land is plowed. A harrow with slanting teeth should be used. After planting, the harrowing may be continued until the corn is several inches high. As already pointed out, the stand of corn is not materially damaged by this practice. Usually after such treatment only one or two cultivations are needed. These cultivations should be shallow, so as not to interfere with the spreading roots of the corn. Usually the small harrow-toothed cultivator is best for this purpose. Such a method of cultivating corn not only secures better yields, but saves a great amount of labor. A Tennessee farmer had a 250-acre field of corn which he cultivated in this manner with a six-mule harrow operated by a boy. During the season only one cultivation by a cultivator was needed. The first year that this practice was tried the corn fields were the cleanest ever

known on the farm, and the yield was much above that on neighboring farms on which the old way of cultivation had been followed.

These same general principles apply in the cultivation of other crops such as tobacco, cotton, beans, cowpeas, and potatoes (see fig. 12). However, with the exception of potatoes, these crops can not be harrowed when growing above ground unless the harrow is run between the rows.

Farm Practice in the Cultivation of Corn, United States Department of Agriculture Bulletin 320, and Farm Practice in the Culti-

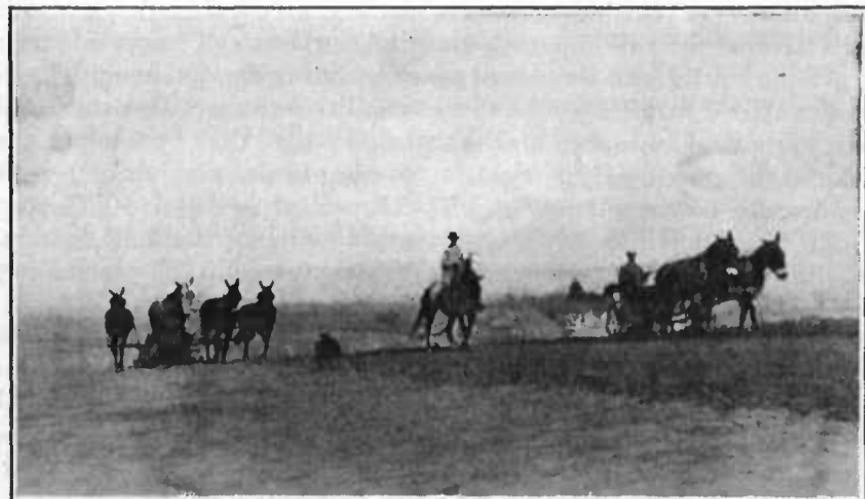


FIG. 12.—A potato planting crew in Jefferson County, Ky. The early crop should be planted as soon as the ground permits in early spring. The field is disked, dragged, and planted at the same time. This is good farm practice here, where a large acreage of potatoes is planted. (Photo by James Speed, Louisville, Ky.)

vation of Cotton, United States Department of Agriculture Bulletin 511, give practical information on methods used by farmers in cultivating their crops.

GOOD SEED.

The selection of good seed is a matter of great importance in securing good crop yields. No matter how good the soil may be, if poor seed is planted much of the money and labor put into soil improvement and upon the crops is likely to be wasted. The crops in this region which suffer greatest losses on account of poor seed are corn, clover, and grasses. The yield of corn may easily be cut down one-third to one-half by poor seed. A poor stand of clover or grasses is frequently due to poor seed or to the mixture of other seeds similar in size and color and which the farmer ordinarily can not distinguish from pure seed.

Corn is more generally raised than any other crop in this region, so that good seed corn is of the greatest importance. Seed corn is easily tested, and the testing takes but little of the farmer's time. He may easily lose half of a normal crop yield by being careless in the matter of testing the seed. A poor stand from the first planting can only be partially overcome by replanting. Usually the first planting is done at the most seasonable time for best results, so that a good stand secured by the first planting will materially increase the crop yield. An uneven stand hinders proper cultivation, and the late-planted corn will not have an even chance with that planted earlier. Even if a fair stand is secured by thick planting of poor seed and by thinning out to a proper stand, the vigorous growth necessary for a good yield will be wanting.

The selection of good varieties is also important. Some varieties are more prolific in yield than others adapted to the locality, so that some farmers have been able to improve greatly their yields by careful selection.

The farmer can further materially increase his corn yields by care in selecting seed from his fields before most of the corn is ripe. This may be done by going through the fields and selecting the ears which have the marks of good quality and vigor.

The same principles of seed selection apply in general to small grains, although it is not as easy to select seed for small-grain crops. Much of the poor seed in wheat, barley, rye, and oats, however, may be eliminated by the use of a fanning mill. By this means the more successful small-grain farmers are usually able to obtain good seed.

CONTROL OF DISEASES AND INSECT PESTS.

Farmers, of course, realize the enormous damage done to crops by various diseases and insect pests, but relatively few have adopted regular practices for combating them. It has been estimated that as a general average about 10 per cent of all crops, including fruit crops, are destroyed each year by various diseases and insects.

Nearly all field crops are subject to diseases and insect ravages, for some of which there are more or less successful and practical remedies. Wheat, for instance, is subject to smut, which frequently cuts down the yield enormously. By the use of chemicals obtained at any drug store, and by the expenditure of a little time in treating the seed, such losses can be prevented.

The Hessian fly is a serious enemy of wheat and barley in parts of this region, especially where these crops are important. Farmers as a rule are familiar with about the only practical remedy for the ravages of this insect, which is to defer sowing until a date proper for the region. The proper time to sow wheat, or other cereals

affected by the Hessian fly, depends on the latitude and altitude. In southwestern Kentucky, where a good deal of wheat is grown, it is not safe to sow wheat until about October 1. On higher elevations and in places farther north the time may be earlier. These insects do not trouble rye to any extent, and oats seem to be practically immune from them. For these reasons these crops may be sown earlier than wheat or barley.

Farmers generally are familiar with the harm done to corn in its early stages of growth by cutworms and other root enemies. The effect of these enemies on crop yields may often be largely overcome by proper rotations and by planting at proper seasons. Thick planting of corn and afterwards thinning to a proper stand is also a practice which to a great extent may overcome the effects of these enemies.

Bulletins are available giving specific directions for the practical dealing with many plant diseases and insect enemies. Farmers will find it profitable to consult these. Thus, by understanding the seriousness of these pests and introducing in the general farm practice the best and most practical means of control, they may greatly improve their yields and frequently avoid disastrous losses.

Important information on some of these problems may be obtained from the following bulletins:

Hessian Fly, Farmers' Bulletin 64, United States Department of Agriculture.
Treatment of Smuts, Farmers' Bulletin 507, United States Department of Agriculture.

DRAINAGE.

Bad drainage is one of the fundamental difficulties in getting good crop yields, and in recent years an increasing number of farmers are finding it profitable to drain land which hitherto has produced poor yields.

Before money or time is spent in attempting to improve the soil the farmer should be satisfied that it drains well, that the water which falls on the land or runs over it will quickly be absorbed under the ground, and that during the wettest times the ground water will not stand within less than 2 or 3 feet from the surface. When water will rise in the soil during any part of the growing season within a few inches of the surface and remain at this level for a day or two, great damage may be done to the growing crop. Such land should have some kind of underground drainage before attempting to farm it.

During the growing season well-drained land will permit the working of the soil a few hours after heavy rains. Draining also prolongs the growing season by enabling the farmer to plant his

crops earlier than could otherwise be done. In these ways crop yields may be greatly improved. It is not always the lowland, however, that is badly drained. Often part of a hillside, or even a place near the top of a hill, is kept too wet by water coming out at the surface. The construction of a ditch above and around such wet places will often remedy this condition. Practical information on drainage may be obtained by reading Farmers' Bulletin 524, United States Department of Agriculture.

USES OF CATCH CROPS AND GREEN-MANURE CROPS.

In the greater portion of this region the growing season is long compared with many other sections of the country. This gives a good opportunity to raise two or more crops on the same field in one year.

A crop may fail for various reasons, and in most such cases there is some other crop adapted to the locality which may be planted the same year to offset largely such failure. For instance, corn, sorghum, millet, cowpeas, or soy beans may follow a wheat crop which has been winter-killed or destroyed early in the season by hail. Under some conditions Canadian field peas may be drilled early into a small-grain crop which has been partially or wholly killed by winter freezing or by some other cause. If the clover or grass crop sown with small grain fails to catch, an early variety of peas or beans may succeed the nurse crop, and clovers and grasses may be sown in the fall to succeed them. If the beans or peas are planted in rows and cultivated, the clover and grass mixture may be sown at their last cultivation. Buckwheat may take the place of beans or peas in such cases, followed in the same manner by clovers and grasses. Other catch crops which may be grown to supplement a main crop are rye, crimson clover, sorghum, or millet.

HINTS ON GROWING ALFALFA.

The raising of alfalfa has not as yet become a general practice in this region, although it will grow on any of the soils where proper preparation has been made. Alfalfa requires a plentiful supply of lime, which must be provided where it is lacking in the soil before this crop can be grown. Usually it can not be grown successfully with a nurse crop, so that it is advisable, as a rule, to sow it alone on a specially prepared seed bed.

The best plan is to begin the preparation of the soil in the spring for sowing in the fall. The land should be reasonably fertile to begin with. Before plowing the ground a good application of stable manure is desirable. In place of this, however, a green-manure crop may be turned under, such as rye. During the summer the land should be frequently disked and harrowed, and, in the meantime, an

application of lime should be given. The usual time of sowing in this region is between August 15 and September 15.

Alfalfa, like sweet clover, has long roots which will penetrate to great depths after moisture. On account of this habit the physical condition of the soil is greatly benefited.

In some parts of the country, particularly in the West, alfalfa will hold the land indefinitely; but in this region a good stand can not usually be maintained for more than 5 to 10 years without a resowing. This is chiefly on account of competition with weeds and grasses. Bluegrass is a special enemy of alfalfa in bluegrass sections. The life of an alfalfa field may be prolonged, however, by cultivation after each cutting. Some have used the ordinary disk harrow with success; but a special alfalfa harrow designed for the purpose is more satisfactory.

The general farmer, as a rule, should not attempt to substitute alfalfa for red clover or the usual clover mixtures, although some farmers have so used it with success. It should generally be reckoned as a supplementary pasture or hay crop, and as such a few acres might be profitably grown on most farms. A few mountain farms have used it with excellent success as a soil improver, as well as for meadow and pasture. Frequently on a mountain farm limestone crops out on the upper portion of a steep piece of land, thus keeping the soil below "sweetened." Under such a condition alfalfa will do very well without the artificial liming of the soil. Sweet clover will also do well under similar conditions.¹

¹ Farmers will find it profitable to read the following bulletins on alfalfa and sweet clover:

Alfalfa and Sweet Clover, Bulletin 178, Kentucky Experiment Station.

Sweet Clover, Circular 129, Ohio Experiment Station.

Sweet Clover: Growing the Crop, Farmers' Bulletin 797, United States Department of Agriculture.

Sweet Clover: Utilization, Farmers' Bulletin 820, United States Department of Agriculture.

Sweet Clover: Harvesting and Thrashing the Seed Crop, Farmers' Bulletin 836, United States Department of Agriculture.

